CLAIMS

1. A process for separating liquid(s) and gas originating from a hydrocarbon conversion zone, said process being carried out in a separation zone comprising three successive sections; the first section, the primary section, functioning for flows with a G/L in the range about 0.1 to 10; the second section, the secondary section, functioning for flows with a G/L in the range about 10 to 50; and the third section acting to limit the formation of a liquid vortex, where G/L is the ratio of the gas to liquid mass flow rates.

2. A process according to claim 1, in which the residence time in the liquid separation zone (200) is in the range 30 seconds to 10 minutes, the range of the ratio of the gas to liquid mass flow rates, G/L, being in the range 0.1 to 10, more preferably in the range 0.5 to 2 at the inlet, the liquid mass flow rates in the separator inlet line generally being in the range 100 to 4000 $kg/s/m^2$.

3. A process according to claim 2, in which the fluid temperature is generally in the range 20°C to 600°C, preferably in the range 300°C to 450°C and the operating pressure is in the range 1 to 200 bars in the separation zone; the dynamic viscosity of the gas is in the range 10^{-2} to 2×10^{-2} cP; that of the liquid is in the range 0.3 to 5 cP; the surface tension is in the range 20 to 70 mN/m; the density of the liquid is generally in the range 500 to 1000 kg/m^3; and the density of the gas is normally in the range 1 to 50 kg/m^3.

4. A process according to any one of claims 1 to 3 applied to separating effluents originating from a hydrotreatment process functioning in the presence of hydrogen and comprising at least one three-phase reactor containing a hydrotreatment catalyst which converts in an ebullated bed, generally functioning in liquid and gas upflow mode, the reaction zone preferably comprising at least one means for extracting catalyst from said reactor located close to the bottom of the reactor and at least one means for adding fresh catalyst close to the

top of said reactor, said reaction zone comprising at least one liquid phase recycling circuit located inside or outside the reactor, and intended to maintain a sufficient degree of expansion of the bed necessary for the bed to function in a three-phase ebullated operation, the process further consisting in that at the top of the reactor, downstream of the bed expansion, an axial gas/liquid separation system inside the reactor can separate the liquid phase to be recycled, the level of liquid in this internal separator being maintained by a line intended for the escape of gas phase and for withdrawing liquid phase products, the flow of these two phases then entering the separation zone of the invention.

5. An apparatus comprising a separation system or separation vessel constituted by three different sections:

- a primary separator (1) for flows with a G/L in the range 0.1 to 10;
- a secondary separator (2) for flows with a G/L in the range 10 to 50;
- a system which limits the formation of a liquid vortex (3);

where G/L is the ratio of the gas to liquid mass flow rates.

5. An apparatus according to claim 5, in which the dimensions of the vessel (200) and the position imposed on the normal level of liquid in vessel (200) are determined so as to impose a residence time in the range 1 to 10 minutes, preferably close to 2 minutes; the separator achieving a separation efficiency such that no more than 0.1% to 0.5% maximum (by weight) of liquid remains in the gas phase at the separator outlet and no more than 0.5% to 1% maximum (by weight) of gas remains in the liquid phase at the separator outlet.

6. An apparatus according to claim 5 or claim 6, in which the primary separator is constituted by a tube terminated by at least one tangential outlet, causing the flow to rotate through 90° at the tube outlet, the ratio of the area of the openings in each tangential outlet and the area of the cross section of flow in the tube being in the range 0.25 to 1, and the ratio between the height and width of each opening being in the range 1 to 4.

6. An apparatus according to any one of claims 5 to 7, in which in the primary separator, a helix is added inside the tube upstream of the tangential outlets, said helix being a single or double helix, the ratio of the helix width, corresponding to the cross section of flow of the fluids, to the tube diameter being generally in the range 0.5 to 1, the pitch number of the helix (i.e., the ratio of the total height to the helix pitch) generally being in the range 1 to 6, and preferably in the range 2 to 3.

7. An apparatus according to any one of claims 5 to 7, in which the secondary separator (2) is constituted by a cyclone with a free tangential inlet, the tangential inlet (6) having a rectangular cross section, and the ratio of the width to the length of this cross section being in the range 0.2 to 0.6.

8. An apparatus according to any one of claims 5 to 9, in which in the secondary separator, the ratio of the cross sectional area of the inlet to the cross sectional area of the cyclone (2) is generally in the range 0.06 to 0.25, the ratio of the diameter of the gas flow outlet line (8) to the cyclone diameter is generally in the range 0.3 to 0.6, and the ratio of the height of the gas outlet line (8) to the cyclone diameter is in the range 0 to 1.

9. An apparatus according to any one of claims 5 to 10 in which, in the secondary separator, the liquid outlet (7a) from the cyclone is always below the liquid level in the separator vessel, the liquid outlet from the cyclone having the same diameter as the cyclone and comprising blades attached to the walls, distributed at a constant angular spacing and being 2 to 8 in number, and the ratio of the width of said blades to the cyclone diameter being in the range 0.15 to 1.

10. An apparatus according to any one of claims 5 to 11, in which said system limiting the formation of a liquid vortex is composed of blades attached to the walls located at a constant angular spacing to dissipate the angular movement, said blades being 2 to 8 in number, and

the height of these blades being in the range between the maximum depth of the liquid and the bottom portion of the primary separator (1).

12. An apparatus according to any one of claims 5 to 12, in which a cylinder is added to the base of the vessel, in the axis of flow of the liquid outlet, said cylinder having the same diameter as the liquid outlet line and a height in the range 0.5 to 2 diameters of the liquid outlet line, said cylinder having massive walls or a wall constituted by a screen and in this case being closed at its upper portion.